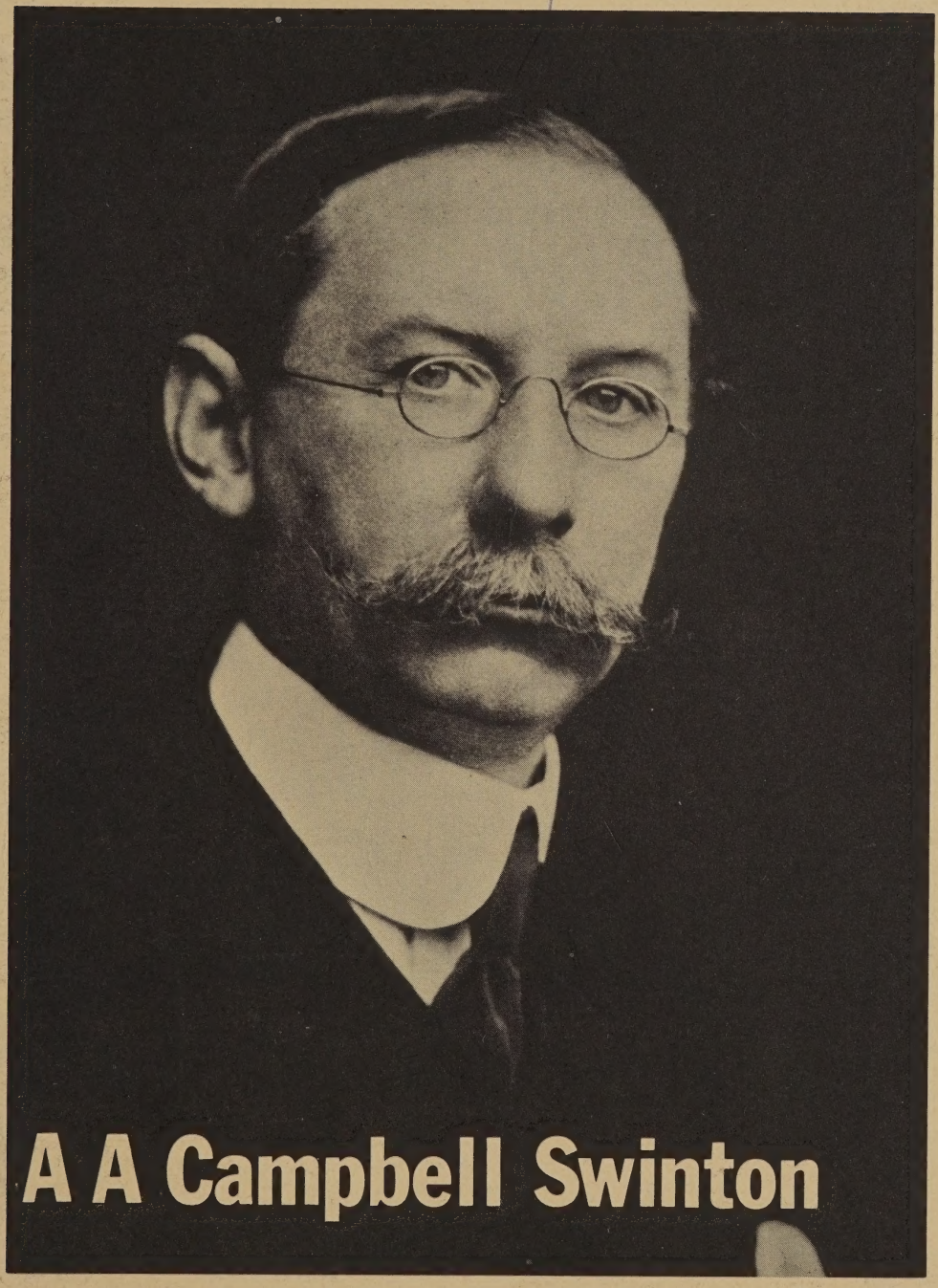
Royal Television Society monograph 1



A A Campbell Swinton

T H Bridgewater

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Royal Television Society monographs
An occasional series of papers on historical and contemporary aspects of broadcast television and related fields, of which this is the first.

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The cover photograph is a portrait of A A Campbell Swinton taken around 1910-11 to mark his term of office as president of the Röntgen Society

Overleaf: Swinton's own bookplate

A A Campbell Swinton FRS 1863-1930

by TH Bridgewater OBE

The name of Campbell Swinton is known in the television world, especially among engineers and scientists, as the originator of an all-electronic concept for the realisation of television. That this was the right approach is now evident by the universal adoption, since the mid 1930s, of those basic principles that he put forward so presciently in the early years of the century before either the words 'television' or 'electronic' were in currency and certainly long before any form of practical television had been achieved. This enlightened foresight — not, however, referred to in most of the published obituaries nor widely perceived in his lifetime — is now acknowledged as the mark of a brilliant mind; but beyond this association with the development of electronic television few people nowadays probably know much of the life and background of this man of culture and of many scientific accomplishments.

Alan Archibald Campbell Swinton, the youngest of three brothers in a family of five, was born in Edinburgh on 18 October 1863. In view of his subsequent career, it is worth noting that at the time of his birth the world had yet to experience the benefits of the telephone, electric lighting or traction, the cinema, X-rays, the steam turbine, the aeroplane, the motor car, the gramophone, wireless telegraphy, broadcasting or television — not to mention numerous other technological developments now commonplace. Yet he lived to see all these brought into use and moreover made important personal contributions to many of them.

His descent can be traced from as far back as one Edulf, first Lord of Bamburgh, who accepted the overlordship of Alfred the Great in 886, and ten generations later through Liulf de Bamburgh and de Swinton (a son of another Edulf, a Saxon who lived before the Norman Conquest). Swinton is a village on the Scottish side of the border near Norham-on-Tweed and ever since Liulf's time this estate has remained in the possession of the Swinton family. The ancestry also includes many men of distinction over the centuries: Scottish warriors, for example, who fought valiantly in famous battles against the English. Such as one Sir John de Swinton who, fighting in France in 1421, unhorsed the Duke of Clarence, brother of Henry V — an incident commemorated by Sir Walter Scott (a kinsman of the Swintons) in *The Lay of the Last Minstrel:*

> And Swinton laid the lance in rest,
> Which tamed of yore the sparkling crest
> Of Clarence's Plantagenet.

Many generations later military skills were being offered in the service of the Union when, for instance, Alan's great-grandfather Captain Archibald Swinton served the East India Company under both Warren Hastings and Lord Clive. It was Archibald's marriage to the daughter of James Campbell of Blythswood, the then head of that family, which introduced the name we find prefixing that of many Swinton descendants.

Other Swintons turned to politics and the law, the twenty-seventh Swinton of Swinton becoming Lord of Justiciary for Scotland; Archibald, the father of our Alan Swinton, also entered the law and became professor of civil law in the University of Edinburgh. In the present century the military tradition

Swinton himself took this whole-plate photograph of his family home, Kimmerghame near Duns in the Scottish lowlands around 1880

has been revived with distinction by many members of the family, including Alan's brother, nephew and great-nephew.

Through the ages the Swintons married into many prominent families and besides the Scotts (as already noted) we find connections with King Robert II of Scotland, the royal Stuarts, two archbishops of Canterbury and the Sitwells — Alan's mother Georgiana being the third daughter of Sir George Sitwell, second baronet of Renishaw.

Swinton was proud, and seemingly with good reason, of his long and often distinguished lineage — even to composing verses in commemoration, beginning with:

Eight Centuries and more, now flown
Did Eadgar on the Scottish throne,
To Odart, Swinton, grant
As Liulf held it so should he
No other service save a fee
For Holy Church's want.

The family home was, and indeed still is after 200 years, at Kimmerghame near Duns in Berwickshire and three miles from the village of Swinton. Here Alan spent much of his early years. He soon displayed a flair for inventiveness and an enthusiasm for experiment. Before the age of six he had constructed a simple ladder designed to assist his mother into bed; also a machine for twisting tow into string and a gallows for hanging Fenians. By that age he was already learning to use a wood-turning lathe.

When still only 10 he became keenly interested in photography, and this hobby lasted through his life; indeed all the portraits of friends which illustrate his autobiography were taken by himself. Photography at that time was in a primitive stage and dry plates, or films such as are common today, had not yet reached the market. His initial attempt involved the chemical sensitising of paper, which he managed to do

himself, and then after building his own camera he succeeded in making first a negative and later a print of his family home after an exposure of two hours. Soon he mastered the elaborate wet-plate process and took many pictures of his family and their many visitors, including one of Professor T H Huxley, later published in *Nature;* even with modern technology this portrait could hardly be improved. Huxley was the first of the galaxy of scientific giants whom Swinton was to know on close terms in the course of his life.

To facilitate the processing of his photographs he devised a portable folding dark tent, fitted out ingeniously to accommodate his camera and all the other necessary equipment — dishes, chemicals, etc — and himself. Alan would load this outfit on a one-horse dog-cart which he himself had learnt to drive. He sent a description to the *British Journal of Photography* who promptly published it. Written both concisely and precisely — a foretaste perhaps of his later clarity of expression — and accompanied by three line-drawings of draughtsman-like style and quality, this first appearance in print must surely have been a wonderful thrill and encouragement for a boy of fourteen.

His eagerness to explore every kind of practical acitivity was unbounded. For instance, he grew flowers and vegetables, gave magic lantern exhibitions, constructed a miniature theatre complete with curtains and gas foot-lights and performing marionettes, and printed his own cards of invitation to the shows. His life-long interest in electricity was evoked when around the age of 11 he was given an electric telegraph set. He soon got this into operation and even learned to make the batteries.

Schooldays

It was about this time that Alan went to his first school — Cargilfield, Trinity, Edinburgh — where he was a boarder and which he 'rather enjoyed' because of the encouragement and instruction given for his practical interests, specially photography, electricity, telegraphy and the like. So by contrast, with such a searching mind and his

At the age of six, Alan was portrayed at his wood-turning lathe in this water colour by his mother, Georgiana, dated March 1870

passion for practical experiment, young Alan Swinton was perhaps an unusual entrant to Fettes College, Edinburgh, where he was enrolled in 1878 at the age of 14. There he found the dedication to sport and to a strictly academic curriculum, presented in a manner that failed to spark the imagination, largely unsuited to his temperament and natural inclinations. Not to put too fine a point on it, and to quote his own reflections in later life, 'I still look upon the greater part of the three years I was at Fettes with horror.'

Although, as he conceded, Fettes during his time turned out many pupils who gained scholarships or did well in university examinations, he himself clearly found little stimulus in that environment. His leanings towards science and practical investigation appear to have been actively discouraged. It is perhaps ironic that later in life Swinton's

visits to Rome and the classical antiquities aroused in him an interest that he rated second only to science in its appeal: he lamented that this subject had not been imparted to him at Fettes in a more human manner.

However, the inhibitions at school did not quell him. By surreptitious means, sometimes rising at 5 am before anyone else was around, or by sly ploys for dodging games, he attempted to pursue his urges to discovery.

It is worth mentioning one important and successful achievement, namely the construction of a telephone. The skill and tenacity behind this particular project must be the more admired by a reminder that Alexander Graham Bell had only made known his famous invention two years previously. Nevertheless, though perforce fashioning all the components from raw materials, Alan succeeded in rigging an installation which afforded communication over several hundred yards between his and another boarding house within the school. It is recorded that 'the speech was loud and excellent', but to have obtained any sort of success at that time and in those circumstances points surely to a boy of marked originality. Alas, the housemaster had other views, and ordered the dismantlement of these precious instruments. Perhaps he was one of those Englishmen who, as Swinton later complained, 'comprised the majority of teachers at this School and who do not understand how to teach Scottish lads'.

At 17, disenchanted with school life and prospects, Alan persuaded his parents to let him leave; since when, to quote the words of this future Fellow of the Royal Society, 'I never passed, or tried to pass, a single examination of any description . . . examinations are a woeful waste of time. I am myself a great believer in self-education.'

However, this brusque dismissal of examinations as such should not be taken to epitomise his views on scientific education generally. Indeed he more than once recorded his opinion that while great inventive geniuses, often without formal scientific education — such as Faraday, Edison, Bell, Hughes and many others — are 'born not made' nonetheless 'with the increased spread of scientific knowledge that suitable education must bring about, invention is bound to benefit greatly'. But it was in keeping with his sentiments while reflecting on his own educational problems when he emphasised that 'the education must be suitable in kind . . . too much learning is apt to cramp originality'. And as to self-education he conceded this would not necessarily be achieved easily: his formula was 'attending lectures at institutions like the Royal Institution and Royal Society of Arts, . . . cultivating scientific friends . . . and reading of technical books and of periodic scientific literature . . . many leading scientific men have owed their education almost entirely to this method'. He strongly advocated the better stocking for this purpose of public libraries and longer opening hours. Though he may have been blessed with more advantages than some, as proof of his theories it would certainly be hard to find a more striking example of a successfully self-educated man than Swinton himself.

On leaving school, Swinton spent the next nine months in France — first in Le Havre and then in Clermont Ferrand — where his searching mind inquired into every aspect of French life and history that opportunity presented. Apart from perfecting his knowledge of the language he enjoyed the theatre, literature, the wine harvest, photographing ancient buildings and many other diversions. Needless to say among the latter was the exploration of anything of scientific novelty — such as a lighthouse lit by an electric arc, a harbour illuminated by 'Jablochkoff' candles (a form of arc developed initially for street lighting and in use in parts of London since 1878), the Michelin rubber factory and, above all, a memorable visit to see the inventions on show at the 1881 Electrical Exhibition in Paris where he saw all the latest devices and machinery, including the first electric tram.

Apprenticeship

Soon after returning home Swinton began, early in 1882, an apprenticeship with Sir William Armstrong the shipbuilder in the

yards at Elswick near Newcastle-on-Tyne. He used his term there to every possible advantage and among other private activities was soon writing magazine articles on electrical topics, while in under two years he had compiled a text book entitled *Principles and Practice of Electric Lighting* which, on the recommendation of no less a notability than Sir William Crookes, was published by Longmans. The book found much acclaim and, under a slightly changed name, ran into several editions and revisions, the last in 1905.

It is fascinating to read this first comprehensive treatment of a subject with which only a handful of technicians at that time would have had any familiarity. Beginning with the basics of magnetism and electricity, their attributes and measurements, he leads the reader through every aspect of this new technology. One learns of 21 kinds of arc lamps with exotic names like the Gulchen, the Serrin, the Jablochkoff, the Rapieff, etc semi-incandescent lamps such as Regniers and Werdermann lamps; and incandescent (then the coming thing though not yet perfected) like the Maxim (with carbonised cardboard filament), the Crookes (carbonised vegetable fibre) and the Swan (carbonised cotton thread). Methods of wiring are carefully explained including, strangely to us now, the pros and cons of parallel and series connecting of lamps. Power sources (important to installers in the absence then of a general mains supply) are fully discussed, eg accumulators, and dynamos driven by gas, steam or hot air engines.

For a young man of 21 this book was a remarkable achievement — and in spare time at that. It greatly impressed Armstrong and his partners, one of whom (Sir Andrew Noble) asked Swinton to plan and supervise the introduction of electric lighting into the warships then being built by the firm — an opportunity and a responsibility that, of course, the young apprentice jumped at. Readers may not by now be surprised to learn that he soon devised some important innovations — including the first use of lead-covered wiring on ships — nor that these extended beyond lighting to other electrical applications including one of the first electric gun-firing controls, this being fitted to a Chilean battleship, the *Blanco Encalada.*

Despite these many pre-occupations during his term at Armstrong's Swinton still found time, and room in his mind, for other topics. In particular his early interest in telegraphy and telephony had lasted and he devised and constructed improved telephone instruments and related equipment. These ideas were also embodied in no fewer than a dozen patent applications.

Professional engineer

In the course of his varied work at Armstrong's Swinton became well acquainted with electrical technology, as well as engines and machinery of all kinds, especially dynamos and the new steam turbines. Thus when he had completed his apprenticeship in 1887, and soon after had moved to London, he was well equipped in knowledge and experience for setting up as an electrical contractor and consulting engineer, with offices at 66 Victoria Street. Incidentally, when his first telephone was installed, only a little more than a decade since Bell's invention, there was only one exchange for the whole of London — still then, as he tells us, using overhead wires and earth returns, with a great deal of consequential cross-talk.

With a reliable incandescent electric lamp now being manufactured there arose a wide demand for lighting installations of all kinds, both public and private, and one of Swinton's first professional activities was the provision of electric lighting in town and country houses, his many clients including the Earl of Durham, the Mackintosh of Mackintosh and Lord Rendel.

These were pioneering days in this new field of electric supply, suiting Swinton's interests and temperament exactly. His experience accumulated fast and his reputation spread. Soon he was able to broaden his interests and connections; he became the London agent for C A Parsons & Co. Ltd of Newcastle. His first directorship was with the Scarborough Electric Supply Co. Ltd for whom he planned and supervised the town's first electric lighting system intro-

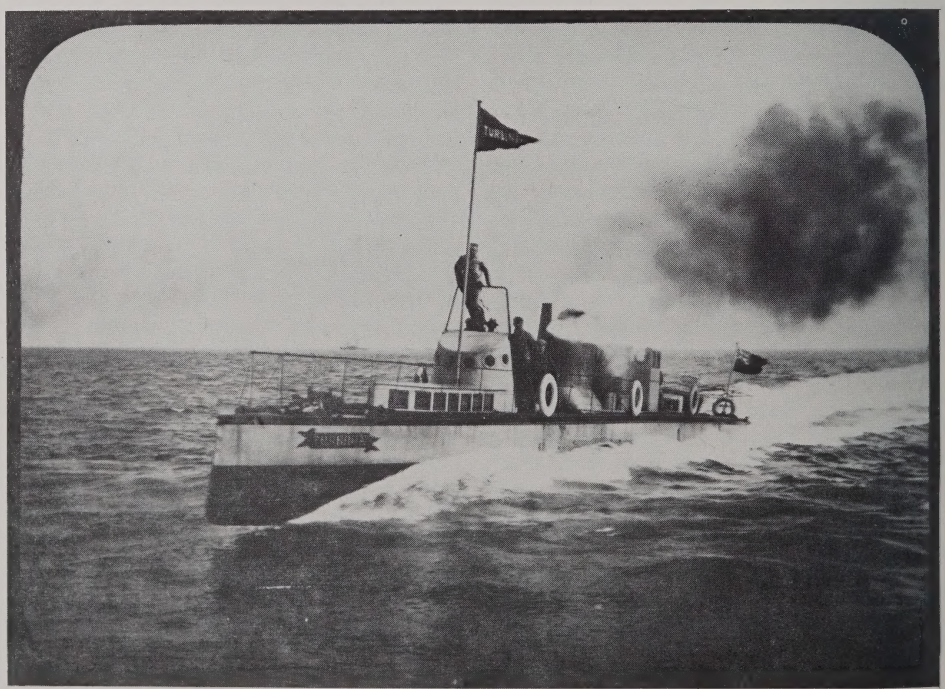
duced in 1893. He also found time for some lecturing and before long began the experimental research, the fruits of which were later to lead him to such eminent standing in the scientific world. He became so active in so many different fields and directions that one can here follow only a few of them.

Since his early encounter with the embryo turbine engine when he was working at Elswick, Swinton had taken a deep interest in this brainchild of the Hon. Charles Parsons. The latter recognised Swinton's qualities and welcomed the co-operation and friendship that was offered. Swinton gave enthusiastic and valuable help — both technical and with business negotiations — during those vital years when the turbine was under development and trial; at a critical moment he also dipped generously into his own pocket.

When the Marine Steam Turbine Co. was formed in 1894 Swinton was a founder-director. This company built at Wallsend the first turbine-driven boat, the 100 ft *Turbinia*, specially intended for testing and demonstrating the new engines. Swinton frequently accompanied Parsons during the speed trials and Admiralty representatives, including Vice-Admiral Henry Oram, were often aboard too. Obviously there were teething troubles and modifications were necessary, Swinton always ready with suggestions. Incidentally he tells us that during these trials the cinematograph was first used for recording the movements of machinery — his own idea, we are tempted to presume. Finally after several years the *Turbinia's* performance was such that, with Swinton still on board, she was able to take part in the Diamond Jubilee Naval Review at Spithead in 1897: speeding at over 34 knots she attracted much attention.

Thereafter the turbine was further improved and widely adopted, and another company (The Parsons Marine Steam Turbine Co. Ltd), with Swinton again as a director, began to build torpedo boats and to build turbine engines for other naval ships,

After being involved in designing and building the SS *Turbinia, Swinton photographed her during sea trials*



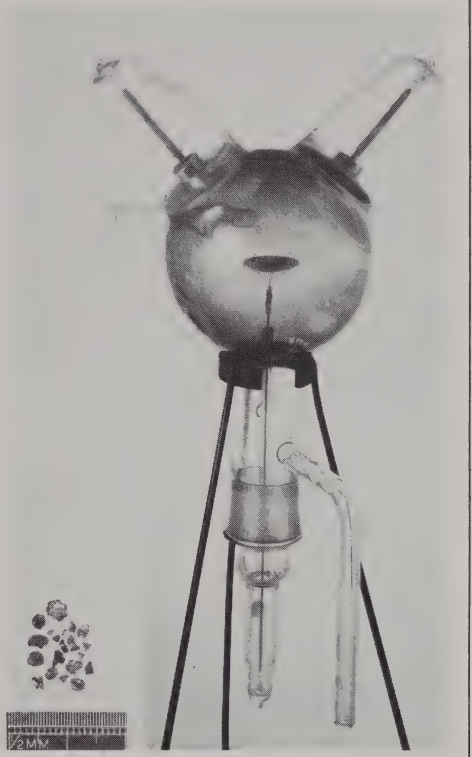
including the original *Dreadnought* battleship. The steam turbine had arrived and stayed.

Dovetailing with his many different pursuits at this time his inventive mind also led him to file further patent applications, some dealing with more improvements to the telephone and telegraph, others covering such subjects as electric signalling, magneto-electric generators, steam turbines — even bicycle handle-bars.

Research and experiment

Swinton's important experimental work, to which reference has already been made, became the foundation of a long series of investigations, mainly into electrical behaviour in low pressure atmospheres. He was impressed by the researches in 1878-79 of Sir William Crookes on the discharge of electricity through highly-exhausted tubes (hence the 'Crookes tube'), a direction of discovery that eventually led to the ubiquitous cathode-ray tube of our day. Swinton soon acquired a Crookes tube and before long was making others in his own laboratory. He became absorbed and fascinated by this new field for investigation and carried out many original observations on the effects of cathode-ray bombardment; these formed the subjects of lectures and papers published in over a dozen scientific journals, though notably in those of the Royal Society and *Nature,* the more important of them appearing in 1896 and through the subsequent 15 years.

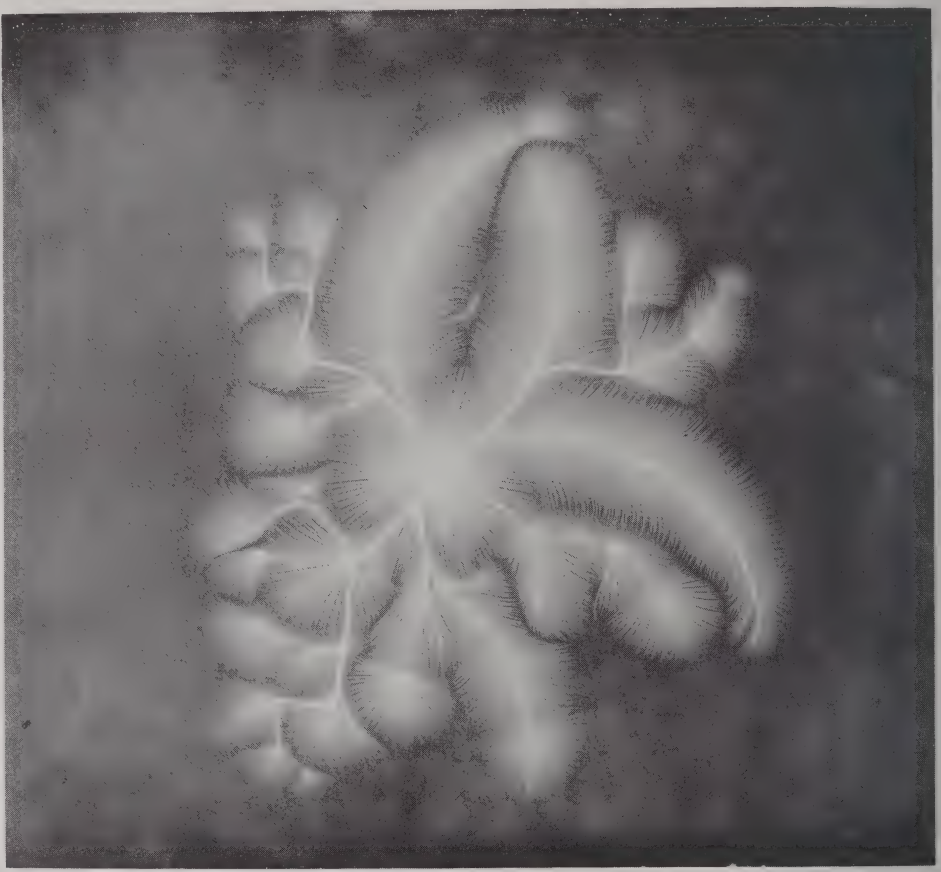
One needs to pause to appreciate the full significance of that mention of the Royal Society. In the very first year (1896, when he was still only 32) that he began publishing the results of his experiments with cathode rays, one of his papers was accepted for the Proceedings of the Society, having been 'communicated' (the normal practice in respect of submissions by non-members) by Lord Kelvin. Thereafter eleven further papers were accepted in nearly as many years, no fewer than five of these also communicated by, and so enjoying the approval of, Lord Kelvin — the others by Sir William Crookes and Charles Parsons. Such an accolade from the 'royalty' of the scientific world convincingly affirms the quality and originality of Swinton's work.



Apparatus used by Swinton for converting diamond into coke, 1907. Some pieces of the coke are also shown. The same tube was subsequently used by Swinton for the manufacture of artificial rubies by fusing alumina and chromium oxide

As a sample of the wide range of these researches a selection of the subjects is listed below:

- X-rays and x-ray photography.
- Luminosity of rare earths when heated *in vacuo* by means of cathode rays.
- Mechanical effects of canal rays.
- Effect of a magnetic field upon electric discharges *in vacuo.*
- Occlusion of the residual gas and the fluorescence of the glass walls of Crookes tubes.



Photographs of high-voltage electrical discharge taken by Swinton and exhibited at the 1892 meeting of the British Association. Above: negative discharge. Opposite: positive discharge. No lens was used. (From Swinton's own prints)

● Conversion of diamond into coke in high vacuum by cathode rays.

The experiment with a diamond was done in 1907 in collaboration with his friend Charles Parsons and is a dramatic example of Swinton's ever-inquisitive probing. Since the diamond was already known as an allotropic modification of carbon he was keen to ascertain whether it could be converted into coke or graphite by heating it in a vacuum under a bombardment of cathode rays. A trial was therefore carried out, and after raising the voltage to 11,000 with a current of nearly 50 milliamperes, a temperature of 1890 degrees centigrade was attained, at which point the diamond disintegrated and was transformed into common carbon. A portion of the latter, as well as the tube in which it was made is now preserved in the Science Museum. It may have been this experiment which triggered in Parson's mind the idea of exploring the reverse process, something rather more appealing perhaps. Anyway, this particular association with Parsons evidently continued, for we find as the latter's subject of his Bakerian Lecture to the Royal Society in 1918: 'Experiments on the Artificial Production of Diamond'. At the conclusion of this lecture Sir Charles,

as he was now, expressed his 'obligations for kind assistance and advice' to several friends, including Mr Campbell Swinton.

These were, of course, the days of cold cathodes in Crookes tubes, with all the attendant extra problems, especially the very high voltages needed: all Swinton's more important researches had to be conducted under these conditions. It was probably not until after the Great War that he was able to experience the advantages of tubes embodying thermionic cathodes. However, his work and publications were not wholly confined to experiments with cathode rays. For example, overlapping this same period he also devoted himself to subjects as diverse as:

- Experiments with high-frequency electric discharges.
- Electricity from water power.
- Experiments with the electric arc.
- Electric transmission gears on motor vehicles.
- A galvanic cell which reverses its polarity when illuminated.
- Experiments with a 10,000 volt storage battery.

The last-mentioned was a bold and prodigious undertaking, involving some 4,800 lead Planté cells — all home made — yielding a voltage of 10,400, the whole weighing nearly half a ton. It was one of very few such batteries constructed anywhere — indeed was then (1911) probably the only one in this country — but Swinton was anxious to study the effect of a direct current source on his Crookes tube experiments. It worked satisfactorily but surely must have been

Hendrik van der Weyde
182 Fulton St N

potentially lethal; as Swinton coolly remarked 'care has, of course, to be taken not to touch the connections . . .'

All these early researches were carried out at the business premises, though when in 1910 Swinton bought 40 Chester Square as his residence and where he lived for the rest of his life, a second laboratory was constructed at the rear of the house. Thereafter experimental work continued at both places.

Swinton's work came to the notice of all the great men of science at that time, most of whom also became personal friends. Indeed it would be hard to pick any name eminent in the scientific world of his lifetime with whom he was not acquainted and, very often, on terms of friendship. His researches and papers were widely valued, and an illustration was evident when one of his papers was submitted to the Royal Society. On being sent for the opinion of a referee, according to custom, it was recommended by the latter 'for publication as soon as possible' since other researchers were urgently awaiting the results of his findings.

X-rays

The subject of X-rays (a term not then in common use but used here for convenience) immediately caught Swinton's interest. On 7 January 1896 he read a press report of Professor Röntgen's discovery in Germany of the X-ray phenomenon and on that same day he himself made a similar experiment with a Crookes tube. To his delight he was immediately able to obtain shadow photographs as he then described them — soon to be known as radiograms and later as radiographs — of various objects opaque to ordinary light; these investigations were, of course, well aided by his considerable knowledge of photography.

He promptly wrote to the *Evening Standard* to report this success, his letter appearing on the 10th. By the 13th he had achieved a photograph of the bones of his right hand, after an exposure of 20 minutes (the original print still exists, safe in the Science Museum).

Opposite: portrait of Swinton in 1898

On the 18th he made a similar but improved photograph which, together with an exploratory article, was reproduced in *Nature* on 23 January — the first X-ray picture of the human anatomy to be made and published in Great Britain.

On 16 January he gave a short report of these experiments to the Camera Club which, because of the current interest in this sensational discovery, had specially delayed its advertised lecture ('Views in the Himalayas') for half an hour, in order to receive a first-hand account without delay. At the conclusion of his talk, Swinton handed round for inspection the first X-ray photographs he had made, much to the astonishment of the audience.

Four weeks later Swinton delivered to the same club a more detailed survey of this 'New Photography', to quote the title of his lecture, and the results he had been able to achieve. At the same time he reviewed the earlier work by other scientists that had led to Röntgen's specific discovery of the effect of these (then unexplained) rays when applied to the human body. In the course of the evening Swinton took X-ray photographs of various concealed objects, also one of the chairman's hand, and developed and exhibited these to the audience.

Swinton's adventurous enthusiasm for scientific discovery could hardly be better illustrated than by the alacrity with which he set about proving and publicly demonstrating X-ray phenomena from the moment he became aware of their existence. He continued to be deeply interested in the subject and soon foresaw its many potential applications, especially in the field of medicine, and after engaging the attention of many scientific bodies he put his own laboratory in Victoria Street — surely the first of its kind — at the disposal of medical men, who welcomed this new diagnostic aid with enthusiasm.

An early example of its value was given by Swinton when he made a radiograph showing a patient's skull with a bullet lodged in it. His work on X-rays attracted wide notice and even the prime minister, Lord Salisbury, attended a demonstration and allowed the bones of his hand to be photographed. On

Swinton's early x-ray photographs — all reproduced from his own prints and slides. Top left: his first success, taken on 13 January 1896, only one week after reading of Röntgen's discovery. Top right: his own hand, taken on 18 January 1896 — the first to be made and published in this country. Bottom left: hand of Sir Richard Webster, showing shots embedded in the flesh. Bottom right: by May of that year quality had improved; the hand of Lord Salisbury, the prime minister

another occasion at a scientific gathering attended by the Prince of Wales — later Edward VII — a similar photograph was shown to HRH, whose only remark thereupon was 'how disgusting'!

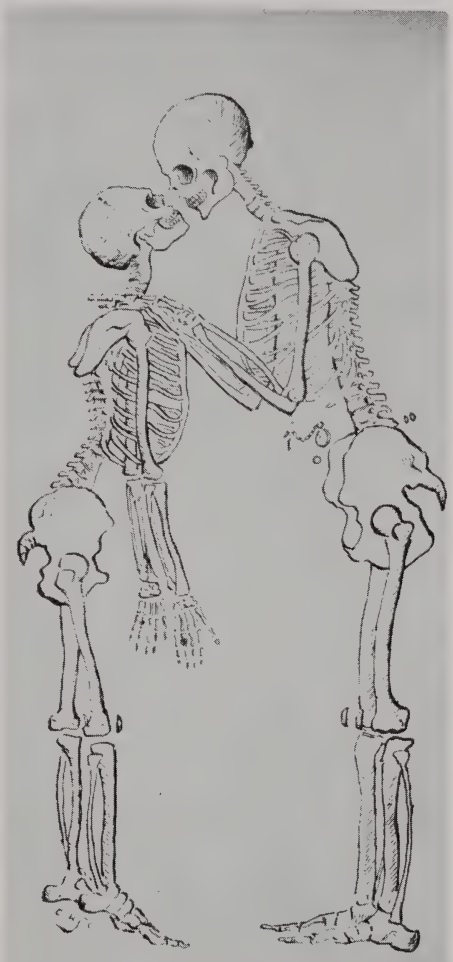
Through 1896 and the following two years Swinton continued to research deeply into this new field and studied many aspects of X-ray behaviour, both electrical and photographic, and the design of X-ray tubes. Moreover his fertile imagination soon led him to suggest, still only within weeks of Röntgen's discovery, 'there seems every prospect by its means of being able to determine the extent of calcareous deposits in the interior organs of the body, malformations and diseases of the bone, etc; it may in time be possible to photograph, or even, and this would be still more useful, to actually see the interior organs in operation.'

As always he was wanting to share his experiences — often immediately sending a letter to *Nature* to mention some new observation or improvement — and gave lectures and wrote detailed reports on his work and findings to many scientific bodies and journals, including the Royal Society, the Royal Institution, the Royal Society of Arts, *Nature* and *The Electrician*. He became a prominent authority in this field and much respected as such.

We should reflect that all this experimental work was by no means Swinton's principal occupation — indeed it was more in the nature of a hobby. He was, as already noted, professionally occupied both as consulting engineer and in electrical contracting. It was only after some 15 years in London, that is not until around 1904, that he decided to give up the contracting part of his business and concentrate mainly on the consultancies which by then were making increasing calls upon his time. However, his experiments and researches continued unabated and with impressive results: he must indeed have been busy.

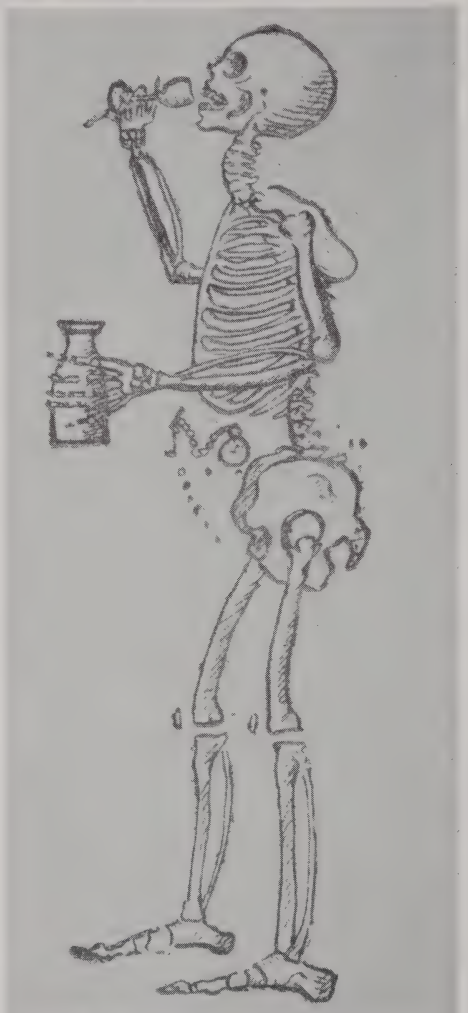
Early wireless

His eye forever ranging over everything new in science, Swinton became closely interested in the phenomenon that came later to be



THE NEW PHOTOGRAPHIC "ART STUDIES."
THE KISS.

Swinton's X-ray demonstrations immediately tickled the fancy of contemporary humorists (published in February 1896). See also overleaf



Have you seen the new photography? We have. We have penetrated into Mr. Swinton's laboratory, and assisted at the diabolical rites. Nothing now is private to us, nothing sacred. We have bones on the brain. This too, too solid flesh has melted, our watch chain dangles in mid air; beyond that is vacuum. All flesh is as grass, we know; but bones are as glass, opaque, impenetrable.

We have taken to raw whisky, and sent our photograph to our mother-in-law.

It is as above.

Please note the entire absence of coin.

called 'wireless' and of course he could readily imagine its probable importance.

His involvement seems to have begun around 1890 when, through Sir William Crookes, he became acquainted with David E Hughes, a Welsh professor of music who had, however, while living in USA, turned his attention and versatile talents to applied physics, including telegraphy and other electrical systems. He invented a type-printing telegraph, the basis of the popular tape-machine that soon followed, and in 1878 when back in London he also invented the microphone, an important enhancement of Bell's telephone of 1876.

It was in the course of further experiments in 1879 that Hughes accidentally hit upon transmission without wires and thereafter was able to repeat and demonstrate this effect over distances of several hundred yards. That this was true wireless and not electromagnetic induction, as some sceptics alleged at the time, and though in fact Hughes himself was uncertain of the correct explanation and even favoured an incorrect one, was later confirmed by Hertz's famous demonstrations some ten years after. So one can imagine how Hughes, with this background of talent and enterprise and already honoured by Fellowship of the Royal Society, would have endeared himself to Swinton.

Hughes died in 1900 and when his widow died around 1920 Swinton was able to rescue many of Hughes' original microphones and other instruments of historic interest, having found them, along with an accummulation of other personal effects, in a furniture repository in Tottenham Court Road where they had lain for over 20 years. These were then safely lodged in the Science Museum, their rightful home. Mrs Hughes had left her husband's notebooks to the British Museum; the latter thereupon consulted Swinton who advised they should be accepted into the permanent archives.

In 1892 Sir William Crookes, writing in *The Fortnightly Review*, gave a brilliantly prophetic forecast of the possible applications of Hertzian waves — though there was at that time no general term of description for these, Crookes referring to them as

'vibrations of the ether' or 'electrical rays'. In this article he spoke of 'the bewildering possibility of telegraphy without wires . . . all the requisites needed are well within the possibility of discovery . . . even now telegraphing without wire is possible within a restricted radius'. He anticipated instruments that would be 'attuned . . . capable of adjustment by turning a screw . . . so as to become receptive to wavelengths of any preconcerted length'.

With such glittering prospects unveiled no wonder Swinton was greatly impressed. He was to comment some 20 years later 'was there ever a more accurate scientific prediction? Sir William Crookes certainly seemed entitled to the description of Major Prophet to the new wireless dispensation'. He felt instinctively that further developments must soon follow: indeed they did, for within two years he saw those first demonstrations of room-to-room wireless transmission by Sir Oliver Lodge at the Royal Institution. Immediately afterwards he himself succeeded in repeating these experiments in his office 'sending signals, ringing a bell and so on through several walls, with a large Tesla high-frequency coil used as a transmitter, and as receiver a coherer consisting of a heap of tintacks'.

Swinton always held Lodge and his researches in the highest esteem and later was to regard Lodge as 'having the first claim to be considered as the original inventor of wireless telegraphy — if such science built on the labours of numerous experimenters can be said to have an inventor'. And Swinton's interest in this new technology was by the happiest of chances soon to prove lucky for one Guglielmo Marconi.

This young man of 21, bitterly disappointed after the Italian government had brusquely rejected his invention without examination or further enquiry, arrived in London with his mother in February 1896. His uncle, Henry Jameson-Davis, took the two of them under his wing and helped them find accommodation and friends. Jameson-Davis was himself an engineer with some influential contacts in the scientific world and, as it happened, was acquainted with Swinton. So when Marconi had set up his apparatus and was giving some private demonstrations in his Bayswater lodgings Swinton was one of those invited to attend. He was greatly impressed and undertook to introduce Marconi to the Post Office which was known to be on the lookout for an effective 'wireless' system, having recently been experimenting with inductive and conductive methods.

Swinton — always resourceful when it came to knowing the right contact in any quarter — thereupon wrote to Mr William (soon to be Sir William) Preece, the Chief Engineer, on 30 March 1896 in the following terms:

'I am taking the liberty of sending to you with this note a young Italian of the name of Marconi who has come over to this country with the idea of getting taken up a new system of telegraphy without wires, at which he has been working. It appears to be based upon the use of Hertzian waves, and Oliver Lodge's coherer, but from what he tells me he appears to have got considerably beyond what I believe other people have done in this line. It has occurred to me that you might possibly be kind enough to see him and hear what he has to say, and I also think that what he has done will very likely be of interest to you. Hoping that I am not troubling you too much.'

Swinton regarded Preece as 'the father of the electrical profession . . . the kindest of men . . . one of the most accessible of Government officials . . . particularly sympathetic to the young'. Certainly Marconi was received with friendliness and encouragement, and offered every facility — with the historic result that we know: the turning point not only in the career of Marconi himself but in the practical development and application of wireless in this country and throughout the world. Thereafter Swinton had 'nothing but the highest admiration for the indomitable perseverance and the exceptional skill he has shown'.

'Electric television'— first attempt

Some years later Swinton began to turn over in his mind the possibility of achieving television (or 'distant electric vision' in the usual parlance of that time) wholly by means

A.A. CAMPBELL SWINTON,
ELECTRICAL ENGINEER.
Telegraphic Address.
"DUNAMIS, LONDON."
TELEPHONE No 3166.
66, Victoria Street,
Westminster, S.W.
A. A. C. Swinton
Guglielmo Marconi Esq
101 Hereford Rd
Bayswater W

Swinton's letter introducing young Guglielmo Marconi to Mr William Preece, Chief Engineer of the Post Office

of cathode rays. He told us that

'not long after the production of the Braun oscillograph in 1897 . . . I actually tried . . . around 1903/4 . . . some not very successful experiments in the matter of getting an electrical effect from the combined action of light and cathode-rays upon a selenium-coated surface, in which I was assisted by the late Professor G M Minchin, . . . and also by Mr J C Stanton. The transmitting apparatus consisted of a home-made Braun oscillograph in which a metal plate coated with selenium was substituted for the usual fluorescent screen, the image to be transmitted being thrown by a lens upon the selenium surface, and the end of the cathode-ray beam being caused electromagnetically to traverse the projected image. Experiments were also tried in receiving with a Braun tube . . . but in its then 'hard' form it proved very intractable.'

This was certainly a bold and imaginative attempt at such an early stage of electronic technology. 'Not very successful' could well be an understatement in relation to its state at that time. We have to note that not only did he then envisage, and attempt to make, a television pick-up tube not dissimilar in form and material from that in current use, but the idea of using a Braun tube as an image-display device was itself a novelty, at least two years ahead of the first patent proposal for any such application and even longer ahead of Rosing's similar suggestion (in that case as part of a complete television system using a mechanically-scanned transmitter).

In retrospect, this was undoubtedly the first proposal for television wholly by cathode ray and the first attempt to achieve that aim in practice. But, alas, the world has not so far formally acknowledged this, for the reason that Swinton was evidently too unassuming, or too disappointed in his result, to write or publish any account of this experiment at the time he made it — indeed it was not until 1926 that he first let this be known in the course of a letter to *Nature*. Yet to have conceived the idea, and even to have achieved a 'not very successful' result in those days, before valves were available or heated cathodes in Braun tubes, is an amazing example of Swinton's imagination and originality and deserves an honoured place in the chronology of television development. Moreover, it is now on record that this actual experiment, as Swinton described it, was repeated in 1936 in the laboratories of Electric and Musical Industries Ltd (EMI) and in fact did prove successful!

Birth of electronic television

In 1908 Swinton saw an article on television in *Nature* by a fellow scientist, Mr Shelford Bidwell, which immediately brought back to mind his own ideas of several years previously. Bidwell was already associated with some early experiments in this field — indeed, some of his ingenious apparatus, capable of transmitting simple silhouettes and dating from as early as 1881, is still to be seen in the Science Museum. In this article he was writing about a proposal put forward by a M. Armengaud in Paris, who with wild optimism was also reported as firmly believing that 'within a year, as a consequence of the advance already made by his apparatus, we shall be watching one another across distances hundreds of miles apart'.

His method envisaged sequential scanning by some mechanical process, with synchronisation between transmitter and receiver, not dissimilar from the earlier Nipkow principle. After commenting on this system Bidwell went on to consider the alternative 'simultaneous' approach whereby each picture element would be linked to the receiver by a separate channel. Either method was fraught with difficulties, the former by the number of picture elements per second to be transmitted and synchronised, the latter by a multiplicity of connecting wires.

Swinton, believing that neither of these methods represented a promising approach to the problem, quickly responded. With an insight based on his considerable experience of cathode ray behaviour, as well as those earlier experiments already recounted, he put forward his own solution in a letter to *Nature* which appeared in its issue of 18 June — a letter now famous for containing the germ of the method by which television has been universally achieved. Such importance justifies reproduction in full:

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Distant Electric Vision.

REFERRING to Mr. Shelford Bidwell's illuminating communication on this subject published in NATURE of June 4, may I point out that though, as stated by Mr. Bidwell, it is wildly impracticable to effect even 160,000 synchronised operations per second by ordinary mechanical means, this part of the problem of obtaining distant electric vision can probably be solved by the employment of two beams of kathode rays (one at the transmitting and one at the receiving station) synchronously deflected by the varying fields of two electromagnets placed at right angles to one another and energised by two alternating electric currents of widely different frequencies, so that the moving extremities of the two beams are caused to sweep synchronously over the whole of the required surfaces within the one-tenth of a second necessary to take advantage of visual persistence.

Indeed, so far as the receiving apparatus is concerned, the moving kathode beam has only to be arranged to impinge on a sufficiently sensitive fluorescent screen, and given suitable variations in its intensity, to obtain the desired result.

The real difficulties lie in devising an efficient transmitter which, under the influence of light and shade, shall sufficiently vary the transmitted electric current so as to produce the necessary alterations in the intensity of the kathode beam of the receiver, and further in making this transmitter sufficiently rapid in its action to respond to the 160,000 variations per second that are necessary as a minimum.

Possibly no photoelectric phenomenon at present known will provide what is required in this respect, but should something suitable be discovered, distant electric vision will, I think, come within the region of possibility.

A. A. CAMPBELL SWINTON.

66 Victoria Street, London, S.W., June 12.

From 'Nature', issue of 18 June 1908

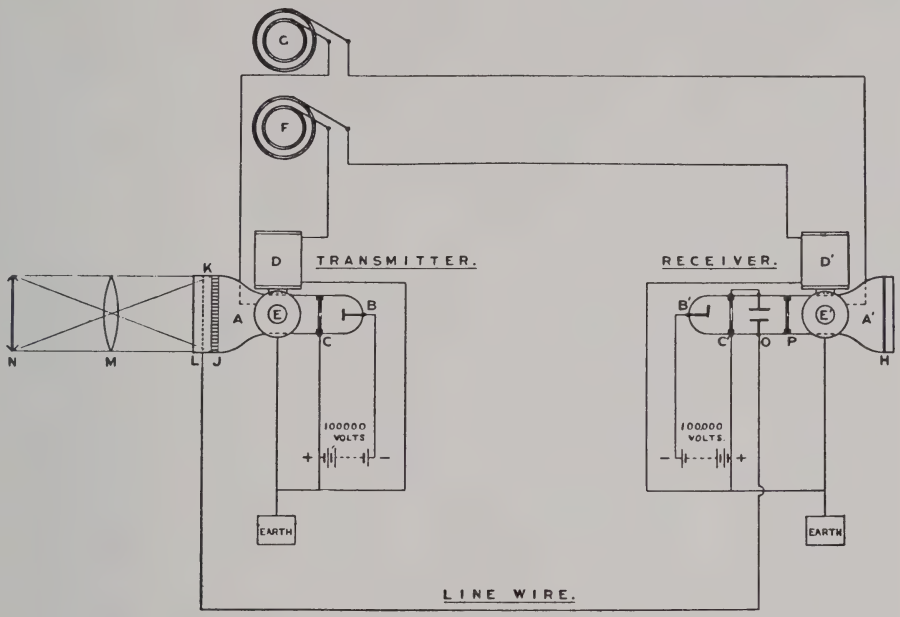


Diagram of electronic television system devised by Swinton to illustrate his address to the Röntgen Society in 1911

Perhaps this suggestion, so far ahead of the means of practical implementation, as Swinton himself implied, stunned rather than stimulated his readers. The correspondence on this subject did not then continue. But it is evident that he was not going to let it drop from his mind and three years later, on 7 November 1911, he brought it up again.

The occasion was his presidential address to the Röntgen Society. After a long philosophical review of the place of science through history in human life and culture — in which, we may note in passing, he prophetically touched on the potential power of atomic energy 'which we may hope to see made available for human use . . . which may in future be destined to proved the salvation of the whole human race . . .' — and then after a searching examination of the second law of thermodynamics in relation to living matter, he turned finally to the topic of 'distant electric vision' (some sentences later he did in fact refer to it as 'television' — a rare use of that word in those days). He devoted at least another 3,000 words to a possible solution to the problem which, he said, 'if satisfactorily solved would have an enormous effect on the habits of mankind'.

After first reviewing the basic requirements and some attempts by others to find the right answer, he presented his own ideas based on, but greatly elaborated in remarkable detail, the former proposal that he had outlined in 1908. He accompanied these with a circuit diagram which — to quote no less an authority than Professor J D McGee FRS, himself a foremost contributor to the realisation of practical television along the very lines advocated by Swinton — 'could be used today to illustrate in essential outline the television system that we now have'. However; Swinton himself, with characteristic modesty, put this forward as 'an idea only . . . only an effort of my imagination . . . a suggestion of a direction in which experiment might possibly secure what is wanted'.

1911: Swinton among friends, all Fellows or future Fellows of the Royal Society. L-R standing: Mr William Duddel, Professor C Vernon Boys, Mr A A C Swinton. Seated: Mr Arnulph Mallock, Professor R W Wood, Lord Rayleigh

The Röntgen Society was not widely known, and apparently the audience was smaller than it might have been because of the attractions of other lectures being given that same evening. This led Professor Sylvanus Thompson FRS, opening the discussion, to declare that those drawn elsewhere 'do not know what they have missed', and after commenting on the other topics in Swinton's address he referred finally to the television 'prediction or suggestion' as 'a most interesting, beautiful and ingenious speculation, and one which is calculated to stimulate thought in many directions'. The *Times Engineering Supplement* was also clearly impressed by these 'speculations' and selected that part of Swinton's address for a prominent and fully detailed report. Clearly this brilliant concept could not, as Swinton said, be 'got to work without a great deal of experiment and probably much modification' but he had shown the way — the right way as we now know.

This subject was never far from his mind through the rest of his life. In 1924 he lectured to the Radio Society of Great Britain on 'The Possibilities of Television with Wire and Wireless' and in this he returned to his earlier theme but adding a number of embellishments made possible by recent technical advances. He had now extended his theories to a point where only translation into practical form could confirm their validity. That to do this would not be a simple task, however, was fully realized by Swinton, who went on in the same lecture to wish that 'we could get one of the big research laboratories, one of those people who has large skilled staffs and any amount of money to engage on the business.' In fact

this happened within a decade but, alas, he did not live to see the outcome.

Swinton's contribution to the technology of television has been fully analysed and appraised by Professor McGee, first in an article in *Nature* (17 October 1936) and again more exhaustively in a monograph for the Royal Society published in its *Notes and Records* in July 1977. In these McGee acknowledges Swinton as the progenitor of modern television, referring to 'the accuracy of Campbell Swinton's idea, his crucial role', 'his influence in guiding the technological development of television along the right lines . . . an enormous step in the right direction.'

Wireless developments

We need now to look again at Swinton's career in the earlier part of the century. He became well-known for his knowledge of and interest in wireless, and he followed every development. For example, in 1910 he went to Copenhagen to witness the Poulsen-Pedersen system of continuous-wave wireless telegraphy operating over a distance of 950 miles. While there he took part in a demonstration of wireless telephony, possibly the first in Europe. He also saw there an instrument (probably the first of its kind) called the 'telegraphone' which recorded speech on a rapidly moving steel wire.

He made many wireless experiments himself and erected aerials of various kinds on the roof of his house in Chester Square, receiving signals from the Eiffel Tower and other transmitters.

He was also deeply interested in recording, whether of telegraph or wireless, morse or speech. As early as 1893 he had acquired a complete Edison phonograph outfit — that is, one machine for recording, the other for reproducing. This provided much interest and amusement for his guests who were able to record their own voices and then hear them played back.

But, typically, he also used this equipment in a more useful and novel manner. As he explained in a letter to his sister: 'I have dictated into a phonograph in my rooms and the cylinder on which the record has been made was then taken down to my office, fixed to another phonograph and from its dictation type-written . . . the chief difficulty is to keep talking sufficiently rapidly not to use up the whole of the cylinder between one's words'. The first dictaphone?

In 1913 he invented and demonstrated an ingenious method of recording signals by which the movements caused in a sensitive manometric flame by the sounds from a telephone receiver were photographed on a moving strip of sensitised paper.

With this background and experience it is hardly surprising to learn that in 1913 Swinton was invited to become the first president of the Wireless Society of London. In the course of a wide-ranging presidential address to a full lecture hall at the Institution of Electrical Engineers he not only demonstrated reception of wireless signals, as well as recording them by his own method mentioned above and by several other systems, but by a *tour de force* that must have astounded his audience he was able to receive and to record, at a pre-arranged time, a special transmission from the Eiffel Tower of a morse message conveying cordial greetings to the Society from Swinton's friend and fellow scientist Commandant Ferrié. The latter clearly had influence with the French wireless service. What is more, he was able to get the same arrangement repeated during his address to the same society in 1920, notwithstanding that by this time surely the Eiffel Tower had become a very busy transmitter.

On this occasion Swinton was able to receive the signals on a frame-aerial inside the hall and again recorded the message, by means of a syphon recorder; a facsimile reproduction of part of this can be seen and interpreted in the report of the meeting. Interestingly Swinton added a curious remark in concluding his address when he said — tongue in cheek perhaps, or a tilt at a certain quarter? — 'one cannot but wonder how many other physical activities there are going on around us . . . but lest I be misunderstood let me impress upon you the desirability of keeping to effects of this kind which have a physical basis . . . for if extended to

psychological phenomena I fear that way madness lies.' However, at a time when many people were still marvelling at the magic of wireless waves apparently penetrating all space — walls, floors and even their own bodies — perhaps such a warning may not have seemed so out of place.

Public appointments

As time went on Swinton was increasingly in demand for directorships and public appointments. In 1913 he was elected to the board of Crompton & Co Ltd (later to become Crompton, Parkinson Ltd) and he was chairman from 1919. He was also a director of W T Henley's Telegraph Works Ltd and of several other engineering concerns.

For varying periods through his life the range of positions held, in addition to those already mentioned, reflects both his standing and his wide interests — for example, president of the Smeatonian Society of Civil Engineers, chairman of the British Scientific Instruments Research Association, member of the executive committee of the British Science Guild, a manager at the Royal Institution, vice-president of the Institution of Electrical Engineers, member of the Broadcasting Board, member of the board of the National Physical Laboratory, consulting engineer to the Metropolitan Police, member of the Delegacy of the City and Guilds Engineering College. He was also a Liveryman of the Goldsmiths Company and a Freeman of the City of London.

In 1917 he was elected chairman of the Royal Society of Arts and held that office for four of the following five years.

His chairman's addresses to that Society are impressive both for their range and for their wisdom. It is worth affording some space to dwell briefly on these and on some of Swinton's other valuable services to the Society. The first two addresses were scholarly treatises devoted to science and its supreme role in mankind's progress through the past, present and future. As he said, 'the great force that impelled inquiry into nature, both in ancient times and in the modern world, was curiosity, which in itself is probably of all human emotions the one that has been the most conducive both to intellectual and to material progress.' With many historical allusions he stressed 'how much of the wealth of the world is due to the mental efforts of exceptional men, who through countless generations, discoveries and inventions have rendered possible all our wonderful possessions'.

Speaking then only nine days after the Armistice, and with the terrible destruction of the war so much still in mind, it was apposite for him to reinforce this theme by emphasising that 'to reconstruct the material things now temporarily destroyed will take only a very small fraction of the labour that had to pass while, by slow degrees and arduous effort, man learned how to bring all these things about . . . When therefore we compile estimates of the losses due to the war, let us not forget that our greatest asset, the vast store of knowledge that science has stored together is still intact . . . one that remains practically indestructible as the real permanent Capital of the Race, and by far its most precious heritage'. (He had put this same theme — obviously one dear to his heart — rather more colourfully on a less sombre occasion, in fact several years before the war, when he asked 'can it be questioned that the discoveries of Archimedes and his disciples have more effect today than the battles of Alexander or Hannibal? Or if we turn to modern times, can it be gainsaid that Watt and Stephenson, Davy and Faraday, have done more to change the course of history and the material conditions of life than did Napoleon or Wellington, Walpole or Pitt?').

Towards the end of these brilliant and fascinating discourses — which when read now are still as arresting as they must have been to his audience of over 60 years ago and from which it seems almost an impertinence to quote only a few lines — he looked far ahead as he often liked to do and speculated on the many possible sources of alternative energy. As he said in conclusion 'in the future may we hope for conquest in ever a wider realm. From now let us look forward to the further triumph of science over the forces of nature, and to the bringing of these

'Joy, joy for ever, my task is done. The gates are past, and heaven is won!' Lalla Rookh

Election to fellowship of the Royal Society in May 1915 was celebrated by Swinton with a jubilant cartoon of himself

1921: Swinton's guests (all FRS's and including six knights) photographed by him at a dinner party he gave in honour of Professor Michelson of Chicago. From Swinton's own proof, with his own numbering.
1, Sir William Bragg; 2, Sir Joseph Petavel; 3, Sir Joseph Larmor; 4, Sir Duguld Clerk; 5, Mr James Jeans (Secretary of the Royal Society); 6, Sir Richard Glazebrook; 7, Major Percy MacMahon; 8, Professor Michelson; 9, Sir Charles Parsons

forces still more into subjection for the common service of mankind; for

> Peace hath her victories
> No less renowned than war.'

The next two addresses were devoted to a comprehensive review of current development in wireless and allied technologies, together with copious demonstrations. The latter included reception from both spark and continuous-wave transmitters of widely varying wavelengths (using multi-stage RF and AF amplifiers), demonstrations of wireless telephony over several miles distance, the Creed automatic receiving and printing system, directional reception and direction-finding by means of frame aerials, phonographic recording of signals received in morse and telephony, as well as recording by means of a Duddell oscillograph. Once again, at an appointed hour, the audience was treated to a transmission from the Eiffel Tower specially sent for the occasion by friend Ferrié — now Général and head of the French Military Wireless Administration — though this time with yet another important difference. The message was both transmitted and received automatically, that is, to quote some of its actual words, 'by automatic perforated tape wireless transmission from the Eiffel Tower Paris for the purpose of being recorded on a Creed type-printing receiver at a meeting of the Royal Society of Arts' — a magnificently successful demonstration of what was probably, as certainly Swinton said he believed, 'the first occasion on which the printing of Roman type of wireless messages has been demonstrated in public'.

In the course of these addresses Swinton shrewdly anticipated the coming of broadcasting and with remarkable foresight prophesied (and this was as early as 1918), 'there is no reason why in the near future we

should not have a public speaker, say in London or anywhere, addressing by word of mouth and articulate wireless telephony an audience of thousands scattered maybe over half the globe.' He was even more percipient, and indeed accurate, when in a later address, though still only 1920, he ventured that 'some day we may have a Prime Minister, or even the Monarch himself, addressing by word of mouth and at one and the same time, all the different parts of the entire British Empire'.

During the years of Swinton's chairmanship of the Royal Society of Arts a severe financial problem arose from the expiry of the lease and so threatened the loss of the Society's premises. He immediately instigated a special appeal fund and himself donated £1,000. Several of his friends also joined in generously and in due course the money was raised.

In 1921 it was largely his advocacy that led to the decision to award the Society's Albert Medal to Professor J A Fleming, a friend whose many distinguished achievements he profoundly admired. In accepting the medal Fleming in return paid a generous tribute to Swinton. The Society was warmly appreciative of Swinton's devotion to its interests and awarded him its Silver Medal for one of his many papers; in 1922 he received special recognition when the president, HRH The Duke of Connaught, nominated him vice-president.

Fellow of the Royal Society

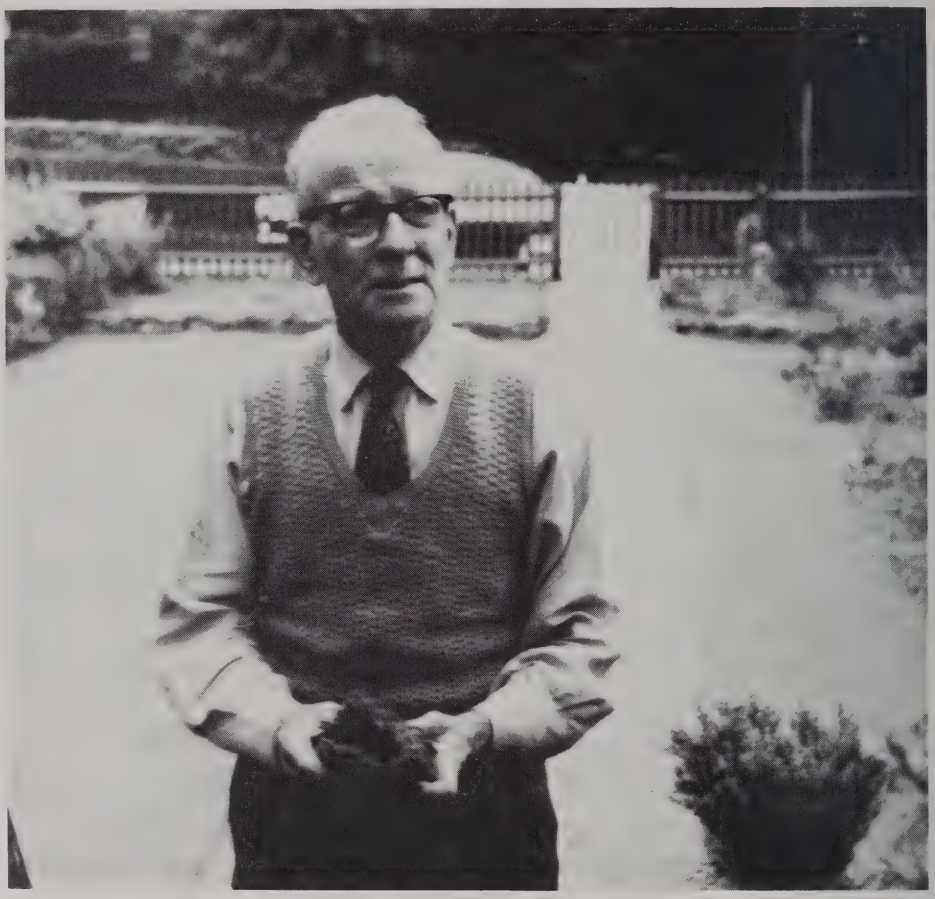
In a very full and, one senses, happy life the event that gave Swinton the greatest pleasure and satisfaction was his election to Fellowship of the Royal Society in 1915. This tribute to his original researches and to his character was sponsored by many of the most eminent scientists, including Lord Kelvin, Lord Armstrong, Lord Rosse, Sir Charles Parsons, Sir Andrew Noble, Sir William Ramsay and Professor Sylvanus Thompson. We need hardly look elsewhere for an assurance of this man's own and equal eminence. Surely a triumphant crowning of his dedication to inquiry and discovery pursued in a field which had first attracted him as an absorbing hobby almost unrelated to his usual professional activities. After election Swinton served twice on the council of the Society and in 1926 he made a gift of £1,000 to form the nucleus of a general purposes fund.

During the war Swinton decided to reduce the scale and scope of his experimental work and presented much of his early laboratory equipment to the Science Museum, where it was gladly accepted. This included telephone apparatus that he had constructed and patented during his apprenticeship, photographs of electric discharges dating from 1892, a print of his first X-ray photograph and no less than 40 Crookes and X-ray tubes. All these items are catalogued and some on display.

After World War I Swinton's experimental work appears to have been largely with wireless, amplifiers, sound recording and similar problems. He installed two-way wireless telephony between his house and his office (his licenced call-signs being 2HK and 2HL) and when in 1919 the Wireless Society staged an exhibition of member's work he demonstrated a powerful directional receiver with a frame-aerial feeding a tuner and seven-valve resistance-capacity-coupled amplifier, all made in his own laboratory and representing an advanced design for those early days.

One project on which Swinton had then been consulted and which much interested him was the 'Optophone'. This clever invention by Dr Fournier d'Albe was a machine for enabling the blind to read ordinary print. By a photo-electric process having some resemblance to television, the response from each letter on a printed page is successively converted into a distinctive musical chord or arpeggio: with practice a blind person can mentally translate the tones into letters and so form words — a kind of musical morse code. After developing amplifiers of adequate power, Swinton actively co-operated in demonstrations of this system to a number of societies and other interested groups.

About this time he even had another try at constructing a television pick-up tube, now using a silica envelope and a heated cathode, but the experiments do not seem



Sydney Langley — Swinton's last laboratory assistant, who worked with him from 1919 to 1923

to have been carried very far as there is no record of any significant result. However, it could well be this work that re-kindled his interest and conviction and led him to prepare the detailed account of the possibilities of a television system which, as already related, he presented in 1924.

Swinton had always employed one or more laboratory technicians from those early days when he became so engrossed in his experimental work. The first to be taken on was Mr J C M Stanton, who had been educated under Professor Minchin at Coopers Hill College and who stayed for over 20 years, assisting with many of the important experiments that established Swinton's reputation. The latter was always meticulous in acknowledging, both at lectures and in writings, the help received from his various assistants. The last of these was Mr Sydney E Langley, the younger brother of Arthur W Langley. The latter, also a fluent French speaker like Swinton, served as a business assistant and confidential secretary, giving 'faithful and untiring service' for nearly 30 years.

Sydney had known Swinton and helped him in his wireless work and in other ways before the Great War. After serving throughout in the Royal Signals he joined his staff in 1919, performing a wide range of laboratory work, even including the blowing

of cathode-ray tubes, during the next four years. We find his name credited for much assistance in preparing and demonstrating the wireless equipment used in Swinton's addresses to the Royal Society of Arts.

The man

Happily Mr Langley survives to give us some first-hand recollections of the scientist's personal characteristics and general mode of life, so perhaps this is an apt moment to consider these. In particular he remembers him as 'kind, generous and friendly to his staff and everyone . . . an interesting person, liked by everybody . . . he liked all sorts of people . . . very popular and good lecturer . . . knew how to talk . . . sense of humour . . . always anxious to help anybody with new ideas . . . used to read a good deal at night and in the early morning . . . always writing . . . always excited when he got something new working . . . very natural and easy-going . . . always too busy for the ordinary things of life . . . hadn't got time to get married . . .'

'Very natural and easy-going' are pleasant enough characteristics to have remembered by those in close contact but the expression 'easy-going' cannot be taken as a generalisation and was probably more typical of leisure occasions, such as motor outings and holidays. More often there was too much of moment claiming his thoughts and attention. His integrity and passionate dedication to truth would certainly have over-ridden all other attitudes whenever he felt that scientific evidence, or credit where deserved, were being scantily treated.

Just one of many examples may be cited. Less than a year before his death his attention was drawn to certain contributions to the *IEE Journal* in which both Mr James Swinburne (a former president) and Sir Ambrose Fleming (both fellow FRSs) discoursed on the work of Sir Joseph Swan. In Swinton's opinion they accorded less than justice to Mr Lane Fox Pitt for (as Swinton put it) his 'valuable and pioneer work carried out in connection with the carbon filament incandescent lamp and electricity supply systems'. He rejoined with a detailed communication in stout championship of Fox Pitt, concluding by asking 'whatever Mr Swinburne or Sir Ambrose Fleming may think or say, what other single invention in electrical distribution has ever been made by anyone, living or dead, that can be compared in comprehensiveness or in importance with this fundamental and epoch-making invention of brilliant adolescence?'

From Langley's and another personal recollection, from the written evidence of his contemporaries and from his own actions, the broader picture of Swinton's personality emerges. A man of kindness and generosity both privately and professionally, always bounteous with praise for the achievements of others or gratitude for services to himself. We have already noted some examples of financial help freely given when needed: yet another instance was his defraying the costs of the charter granted to the British Association.

His respect for the wonders of nature and the gradual unfolding of its treasures by scientific observation shines through the whole of his life and work. And each new revelation that he himself had any hand in uncovering was for the world to share; this was an essential part of his generosity and his modesty and, in a way, his humility. All the sources agree on his capacity for friendship and the extent to which he was in turn respected by so many friends.

Swinton's niece, Mrs Mariora Erskine, who lived in his house and knew him during the last five years of his life, has told the author that she remembers his usual demeanour as being quiet, reflective, perhaps sombre. In these later years the sense of humour mentioned by Langley seems to have shown itself only occasionally in the home. But then few of his family or friends knew what his doctor had told him in 1924 following an X-ray examination, namely that his life might be cut short at any moment.

However, it is clear from his own writings that Swinton enjoyed a humorous anecdote; he often also enlivened his comments on less serious subjects with a blend of subtle wit and gentle fun, as one finds for example in certain of his letters to the press. And surely in his earlier days there were some light-

hearted moments, such as in 1911 when he liked to dine at a club calling itself 'ye sette of odd volumes' where the president was called 'his oddity' and addressed as 'your oddship'.

Then there was the incident of the dog that Langley relates: 'another funny thing: the housekeeper was very worried about the front doorstep at Chester Square — dogs used to visit it — she used to put cayenne pepper down — didn't make much difference — she asked the Governor one day — "any idea what we can do?" He thought it out and one Sunday when it was dry and warm he put some little troughs of calcium phosphide down by the front doorstep — if you put water on it, it bursts into flames — another very successful experiment! He was watching at the window to see what happened and got a lot of fun out of it.'

Even when he was past 60 there must still have been many claims on his time by his various public and business appointments, the duties of which he performed assiduously. He also regularly attended lectures (still apparently self-educating!) and was always ready to contribute to subsequent discussions, often enlivening these by reminiscences and anecdotes of his varied experiences and the many prominent people he had known throughout his life. He was himself in demand as a lecturer and freely responded.

Though he never lost interest in experiment and in scientific progress, almost all human activities fell under his gaze and he was often moved to contribute to newspaper correspondence columns. Indeed, for years he had been writing to *The Times* on a variety of topics — some arising from his professional interests, others as diverse as, for example: tramways on the embankment, dangerous high-roads, telepathy, water-divining, the Maria Theresa dollar, Sunday admission to Shakespeare's tomb. He was well rivalled in these *Times* appearances by his brother and other relations: it seems to have been a family pursuit.

Television debate

The future of television remained an abiding interest, and by now he was becoming convinced that mechanical methods of television, then much in the news, could not survive as a viable basis for the future. He put his word in, plainly and outspokenly, whenever he felt called upon: for example by a letter to *Nature* in 1926 drawing attention to his early experiments and proposals, by a series of letters to *The Times* in 1928 and 1929, by correspondence with the BBC, and by several articles on the future prospects for television.

At this time — that is, from 1928 onwards — there was an active lobby on behalf of Baird's mechanical television, the only method which had then achieved any success, so Swinton felt the more impelled to voice the other, and of course his own, viewpoint on the future direction. All the same he was not condemning other methods in the dark. He learned what he could about the results so far achieved, attended lectures by Baird and tried, though for a long time unsuccessfully, to see Baird's own demonstrations. As he confided to a friend, he was disappointed that the whole subject of television 'had been spoilt scientifically by the absurd statements about Baird's experiments'.

Almost alone he continued to raise his voice in dissent. In an article in *Modern Wireless* in 1928 in which he had widely surveyed the progress of television, he concluded: 'Surely it would be better policy if those who can afford the time and money would abandon mechanical devices and expend their labours in what appears likely to prove the ultimately more promising method in which the only moving parts are imponderable electrons.' He attacked mechanical television even more forcefully when a few months later he wrote in *Discovery* that it 'can only lead to a dead end beyond which no improvement is possible'. Moreover, he was not without one staunch and influential ally in Sir Oliver Lodge. The latter saw the future of television in precisely the same light and a short while before had plainly supported Swinton's view when, in an article in *Popular Wireless,* he declared his belief in cathode rays or moving electrons as 'the only things likely to be sufficiently docile and controllable to be used as the agents for television'.

Swinton at the wheel of his 1903 Talbot car

Another article — apparently the last Swinton wrote — had been commissioned by the BBC in 1929 for publication in their forthcoming 1930 Yearbook. In this he gave an interesting and comprehensive survey of the inherent problems of television, of the progress in its technology over the preceding half-century, and of speculations on its future course of development, in which he did not neglect to point, once again though of course quite correctly, to the inevitability of an all-electronic solution.

Alas the BBC later changed its mind and decided for reasons of 'tactics' to 'ignore television in the 1930 Yearbook': the Director of Public Relations personally wrote on 30 August and returned the script to the author. A strange 'tactic' one might think, seeing that exacly one month hence the BBC was due to pass a milestone by beginning to broadcast television regularly from Baird's studio using a 30-line, albeit mechanical, system. However, the same letter went on to tell Swinton that his 'point of view was very much that of the Corporation', so perhaps there might have been some embarassment to have to publicise an association with a system that Swinton's article was strongly condemning — even though as a matter of history, this was the initiation of television broadcasting in Great Britain, crude and unpromising though it may have been at the outset.

In the *Times* letters Swinton took issue with one Dr J Robinson who had written in

defence of current mechanical systems of television and had even challenged the accepted relationship between picture definition and frequency by rather outrageously suggesting 'the transmission of small scenes at present will be possible with a much smaller frequency-band than that required for a telephone service'. Of course Swinton could not accept this and vigorously pointed out the correct analysis.

The argument continued and over several months four or five letters were exchanged through *The Times* columns, and one or two others joined in. Swinton's views attracted wide attention. A year later, in fact only two months before he died, his last letter appeared. It bears a touch of poignancy, for he had just witnessed a 30-line television broadcast, possibly the only television reception he ever saw. Although this was being achieved through a mechanical system that he knew could not prevail in the long run he generously commented that 'the transmission was very successful'. If only he had lived another few years he would have seen television developing along the very lines that he had long before so brilliantly conceived and advocated.

Later days

Busy though we know he always chose to be, Swinton was probably able during his last decade to devote a little more time to his hobbies and private interests. Earlier he had been a pioneer motor-cyclist and motorist, and motoring tours both at home and abroad remained a favourite occupation. He had long been a director of the French Delahaye company and had owned several cars of that make since 1908, the last a huge six-cylinder model custom-built to his requirements and often driven by Sydney Langley when Swinton's short-sightedness was becoming a handicap. This unusual car — 'that great tremendous monster' according to Sydney — seems to have attracted much attention. 'When we went to Edinburgh we kept the car in a big garage in the castle. People from all over the world came there and of course it caused quite a sensation!' The engine and gear-box of one of his earlier Dalahaye cars now rest in the Science Museum.

His tours included visits to Scotland, his homeland, where lived many of his relations and friends, to France where he always retained personal and business connections, and further afield to the lands of classical art and antiquities. Photography was still a hobby, especially on these travels, but his true relaxation was probably the society of friends both at his home and at the Athenaeum, where he was a popular member and frequent attender since 1901 (when he had been proposed for election by Sir Andrew Noble and Lord Kelvin). He delighted in offering good conversation and hospitality and often entertaining his friends by demonstrating some new scientific 'toy' or bringing out the large collection of photographs he had taken of the many eminent men he had known. Indeed it was not uncommon for him to arrange his guests in a group and photograph them on the spot. One of the prints depicts an assembly of nine guests, all Fellows of the Royal Society and including six Knights — all, as usual then, dressed in full evening dress.

His pen was never dry for long and in addition to some poetry, a few samples of which we are seeing, he wrote his autobiography and illustrated it largely by photographs taken by himself of some of the eminent men he had known. This is a beautifully discursive account of his life and experiences as well as his thoughts on mankind's future course and needs, especially of alternative sources of energy — so often a topic that occupied his mind — with speculations on the possibilities of solar energy (a subject on which, incidentally, he had broadcast from 2LO in 1924), water-power, plant life, tides and much else, and finally atomic energy, of which he clearly appreciated the theoretical potential: 'the solution to this problem would be the culminating discovery in the field of science as we now know it in bringing the forces of nature into subjection for the common service of mankind'. This last-mentioned notion was one on which, as we have already remarked, he had publicly expressed the same insight and outlook as early as 1911.

How sad it is that Swinton died on 19

February 1930, a few weeks before his book came off the press, and that obituary memoirs were bound into it. But how thankful we must be for its completion since it embodies so much of what we know of the man and certainly of what I have been able to recount here; though for a full appreciation of his scientific achievements and of his philosophical and civilised attitude to life — or if only for enjoyment of his graceful use of the English language — readers are commended also to his other published writings and especially to his several presidential and chairman's addresses.

The life and achievements of Swinton deserve a more comprehensive record with a deeper appraisal of his scientific contributions. I can only hope that this brief introduction may stimulate some further interest in an adventurous scientist and man of vision.

Our past is but a moment
Compared with boundless time,
Our earth a tiny sand-grain
Astray in space sublime.

Ourselves with dull perceptions
Inherently in thrall,
With certainty how can we
Know anything at all?

Perhaps in composing these lines Swinton had in mind some words of Hippocrates that he had quoted when concluding one of his lectures: 'Art is long, opportunity fleeting, experiment uncertain, judgement difficult'.

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Mrs Jane Harris
My wife, Jean

T H Bridgewater OBE has been involved in television broadcasting since its earliest days. He joined the Baird Television Company at its Long Acre premises in 1928 and later, after being closely associated with the experimental transmissions of the 30-line mechanical system, he joined the BBC as one of the first three television engineers when the Corporation took over full responsibility for television transmissions in 1932.

When television was revived after the Second World War, Tony Bridgewater, as Superintendent Engineer, Television Outside Broadcasts, was one of the key figures in arranging the first cross-Channel and international programme exchanges from 1950 onwards. From 1962 until his retirement in 1968 he was chief Engineer, BBC Television.

He was chairman of the council of the Royal Television Society from 1952 to 1954 and is a fellow of the society.

A A Campbell Swinton

The idea of a television system based entirely on electronic principles occurred to Alan Archibald Campbell Swinton a quarter of a century before it was finally realised by EMI and adopted by the BBC Television Service in the mid 1930s. 'Distant electric vision' was only one of many subjects which interested this prolific self-educated inventor and experimenter. By profession a leading electrical engineer (and author, while still an apprentice, of a successful textbook on electric lighting), he was also a pioneer in the field of X-ray photography and cathode ray bombardment. He also provided the crucial introduction to the Post Office for a young Italian whose work was to revolutionise communications: Guglielmo Marconi.
In this first of a series of Royal Television Society illustrated monographs, T H Bridgewater examines the life and achievements of the man who fills an important early niche in the history of television.

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